Petroleum Science and Technology 2018

# Aquathermolysis of heavy oil in reservoir conditions with the use of oil-soluble catalysts: part III–changes in composition resins and asphaltenes

Varfolomeev M., Nurgaliev D.
*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

## Abstract

© 2018, © 2018 Taylor & Francis Group, LLC. This paper discusses aquathermolysis process of heavy crude oil from Boca de Jaruco reservoir, which is developed by CSS method. The catalysts based on cobalt, nickel, iron and cupper are used to intensify the in-situ conversion processes. The active form of catalysts generates after steam injection. The third part of paper discusses conversion of resins and asphaltenes. The influence of thermo-catalytic conditions and composition of catalysts are also studied. The destruction of resins and asphaltenes are observed after thermocatalytic treatments. The changes in composition of resins and asphaltenes are revealed by IR-spectroscopy data.

http://dx.doi.org/10.1080/10916466.2018.1514413

## Keywords

aquathermolysis, asphaltene, catalyst, FTIR-spectroscopy, heavy oil, in-situ upgrading, transition metals

## References

[1] Andreatta, G., C. C., Goncalves, G., Buffin, N., Bostrom, C. M., Quintella, F., Arteaga-Larios, E., Perez, and O. C., Mullins. 2005. Nanoaggregates and structure-function relations in asphaltenes. Energy & Fuels 19 (4):1282–9. doi:10.1021/ef0497762

[2] Buckley, J. S. 1996. Microscopic investigation of the onset of asphaltene precipitation. Fuel Science and Technology International 14:55–74. doi:10.1080/08843759608947562

[3] Feoktistov, D. A., G. P., Kayukova, A. V., Vakhin, and S. A., Sitnov. 2018. Catalytic aquathermolysis of high-viscosity oil using iron, cobalt and copper tallates. Chemistry and Technology of Fuels and Oils 53 (6):905–12. doi:10.1007/s10553-018-0880-4

[4] Frakman, Z., T. M., Ignasiak, E.M., Lown, and O. P., Strausz. 1990. Oxygen compounds in Athabasca asphaltene. Energy & Fuels 4 (3):263–70. doi:10.1021/ef00021a008

[5] Gafurov, M. R., M. A., Volodin, A. A., Rodionov, A. T., Sorokina, M. Y., Dolomatov, A. V., Petrov, A. V., Vakhin, G. V., Mamin, and S. B., Orlinskii. 2018. EPR study of spectra transformations of the intrinsic vanadyl-porphyrin complexes in heavy crude oils with temperature to probe the asphaltenes' aggregation. Journal of Petroleum Science and Engineering 166:363–8. doi:10.1016/j.petrol.2018.02.045

[6] Ivanova, A. G., A. V., Vakhin, E. V., Voronina, A. V., Pyataev, D. K., Nurgaliev, and S. A., Sitnov. 2017. Mössbauer study of products of the thermocatalytic treatment of kerogen-containing rocks. Bulletin of the Russian Academy of Sciences. Physics 81(7):817–21. doi:10.3103/S1062873817070139

[7] Kayukova, G. P., A. M., Kiyamova, A. N., Mikhailova, I. P., Kosachev, S. M., Petrov, G. V., Romanov, L. M., Sitdikova, I. N., Plotnikova, and A. V., Vakhin. 2016. Generation of hydrocarbons by hydrothermal transformation of organic matter of Domanik rocks. Chemistry and Technology of Fuels and Oils 52 (2):149–61. doi:10.1007/s10553-016-0685-2

[8] Kudryashov, S. I., I. S., Afanasiev, O. V., Petrashov, A. V., Vakhin, S. A., Sitnov, A. A., Akhmadiayrov, M. A., Varfolomeev, and D. K., Nurgaliev. 2017. Catalytic heavy oil upgrading by steam injection with using of transition metals catalysts. Neftyanoe Khozyaystvo–Oil Industry 8:30–4. doi:10.24887/0028-2448-2017-8-30-34

[9] Lei, Y., Y., Bin, and Z., Tao. 2017. Gasification of n-C7 asphaltenes using Ni-based catalysts. Petroleum Science and Technology 35 (24):2283–6. doi:10.1080/10916466.2017.1402033

[10] Maity, S. K., J., Ancheyta, G., Marroquin. 2010. Catalytic aquathermolysis used for viscosity reduction of heavy crude oils: A review. Energy & Fuels 24 (5):2809–16. doi:10.1021/ef100230k

[11] Muraza, O., and A., Galadima. 2015. Aquathermolysis of heavy oil: A review and perspective on catalyst development. Fuel 157 (1):219–31 doi:10.1016/j.fuel.2015.04.065

[12] Ren, T., Y., Wang, and G., Zhang. 2017. Influence of the properties of resins on the interactions between asphaltenes and resins. Petroleum Science and Technology 35 (14):1481–6. doi:10.1080/10916466.2017.1347677

[13] Salih, I. S. S., I. I., Mukhamatdinov, E. I., Garifullina, A. V., Vakhin. 2018. Study of fractional composition of asphaltenes in hydrocarbon material. Chemistry and Technology of Fuels and Oils 54 (1):44–50. doi:10.1007/s10553-018-0896-9

[14] Schuler, B., G., Meyer, O. C., Mullins, and L., Gross, 2015. Unravelung the molecular structures of asphaltenes by atomic force microscopy. Journal of the American Chemical Society 137:9870–6. doi:10.1021/jacs.5b04056

[15] Sheu, E. Y., D. A., Storm, E. Y., Sheu, and O. C., Mullins. 1995. Asphaltenes: Fundamentals and applications, (Chapter 1). New York: Plenum Press.

[16] Sitnov, S. A., M. S., Petrovnina, D. A., Feoktistov, D. R., Isakov, D. K., Nourgaliev, and M. I., Amerkhanov. 2016. Intensification of thermal steam methods of production of heavy oil using a catalyst based on cobalt. Neftyanoe Khozyaystvo - Oil Industry 11:106–8.

[17] Spiecker, P., K., Gawrys, C., Trail, and P., Kilpatrick. 2003. Effects of petroleum resins on asphaltene aggregation and water-in-oil emulsion formation. Colloids and Surfaces A: Physicochemical and Engineering Aspects 220:9–27. doi:10.1016/S0927-7757(03)00079-7

[18] Strausz, O. P., T. W., Mojelsky, and E. M., Lown, 1992. The molecular structure of asphaltene: An unfolding story. Fuel 71 (12):1355–63. doi:10.1016/0016-2361(92)90206-4

[19] Vakhin, A. V., S. A., Sitnov, I. I., Mukhamatdinov, Y. V., Onishchenko, and D. A., Feoktistov. 2017. Aquathermolysis of high-viscosity oil in the presence of an oil-soluble iron-based catalyst. Chemistry and Technology of Fuels and Oils 53 (5):666–74. doi:10.1007/s10553-017-0848-9

[20] Yusupova, T. N., Y. M., Ganeeva, G. V., Romanov, E. E., Barskaya, V. I., Morozov, E. S., Okhotnikova, and A.V., Vakhin. 2017. Change in the structural-group composition of bitumen asphaltenes upon thermal bitumen recovery. Petroleum Chemistry 57 (3):198–202. doi:10.1134/S0965544117020256